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ABSTRACT

This plan for the introduction of high technology instructional programs at Los Angeles Trade-Technical College was designed to help the college meet the staffing needs of local companies for technicians trained in high technology fields. After an introductory discussion of the changing nature of the labor market and its impact on college programs, Chapter I presents an instructional model for high technology programs which includes curriculum programs, programs for foreign students, pre-high-tech programs, instructional contracts, weekend college, and after-school enrichment programs for junior and senior high school students. Special focus is placed on plans for developing a School of Science, Engineering, and Technology, a Computer Center, and a High Technology College Advisory Committee. Chapters II through V present course descriptions, budget projections, and other information on four new programs: High Technology Associate in Science Degree Programs; an Electrical Engineering Technician Technology Program; a Machine Shop Computer-Assisted Manufacturing Technician Technology Program; and a Computer-Aided Design/Computer-Aided Manufacturing Technician Technology Program. Finally, chapter VI explains the support role to be taken by the college's Science-Math Department in the implementation of the high technology program, summarizes the currently offered associate in science degree programs, and lists pre-tech and industry training modules. (HB)

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LOS ANGELES TRADE-TECHNICAL COLLEGE

MASTER PLAN

for

THE INTRODUCTION

of

HIGH TECHNOLOGY INSTRUCTIONAL PROGRAMS

JC 840 494

OFFICE OF INSTRUCTION REPORT NO. 82-1

May 10, 1982

ACKNOWLEDGEMENTS

In December, 1980, the faculty, staff and administration of Los Angeles Trade-Technical College joined together to explore the future direction of "high technology" and the role that the college could occupy with respect to the Los Angeles Community College District's desire to provide Los Angeles with high technology educational programs. The high-tech committee composed of the following faculty and administration gave a substantial amount of time to develop this master plan which will serve Los Angeles Trade-Technical College as a guide in the development of high-tech programs.

Victor Veley - Assistant Dean, Office of Instruction, Committee Chair

Neil D. Adams, Ph.D. - Coordinator, Electrical-Mechanical Department

Lucian L. Carter - Chairperson, Math-Science Department

Harold Eckes, Jr. - Coordinator, Learning Resources Center

Daniel Peppard - Coordinator, Printing & Lithographic Trades Department

Joe P. Rios - Coordinator, Metals Technology Department

Peter Rauterkus - Associate Professor, Metals Technology Department

Jose Cortez - Instructor, Metals Technology Department

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Thomas G. Lakin

Dean of Instruction

May 10, 1982

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INTRODUCTION

A CURRICULUM PROPOSAL FOR THE AGE OF HIGH TECHNOLOGY

Technology is basically the business of doing things by means of objects or devices that are not part of our body. If we try to squeeze a lemon with our teeth, we are being natural. If we use a lemon squeezer to do the same job, that's technology. The earliest histories of primitive people indicate that they were technologists. They shaped rocks designed to cut and chip materials; they carved wood into working tools. Whenever these primitive people saw a way of doing something better by a device outside themselves, they seized the opportunity. They became technologists.

The United States has changed from an agricultural to an industrial society during the last hundred years. The industrial revolution peaked in 1920 when well over 50% of the work force was employed in manufacturing industries. At the present time, the United States is undergoing another revolution which will completely change the nature of our society in the 21st century. At the beginning of the 21st century, only 2% of our total work force will be needed in agriculture and only 22% in manufacturing. In contrast, about 66% or over two-thirds of the working people in the United States, will be employed in information type occupations.

This change from an industrial to an informational society is taking place so rapidly that few of us are conscious of the full effects on our daily lives. Many of our long distance calls are routinely directed through circuitry located in space. The publishing industry transmits editorial composition to printing presses around the world by satellite. These are but two small examples of the developing information society.

A major problem facing the American economy in the 1980's is the need to create millions of new jobs to provide opportunities for the young people of the United States, thus helping to reduce the burden of unemployment. Today, literally tens of thousands of individuals who have been laid off from manufacturing industries, particularly heavy industries such as automobile, steel, and farm machinery, will never be re-hired even when the economy recovers. These jobs are gone forever because these industries must find ways to be more competitive by improving their productivity These industries are spending, or soon will, billions of dollars on capital improvements to install more automated equipment, particularly robots, to replace people whenever and wherever possible in the work place. A recent good example of superior automation is one auto assembly unit in Japan that operates each shift with only six full-time employees. This is a typical example of the level of competition facing American industry. To compete, our basic industries must become less labor intensive. In the future, our country cannot look to major manufacturing industries as a way of increasing employment opportunities. The major new job opportunities in our industries will be at the engineering and technical level, rather than at the production level. If less than 22% of the people in the United States will be working in the manufacturing industry, it follows that there will be a dramatic decrease in the student populations in the traditional trade instructional areas of metals, welding, foundry, and forging. In contrast, there will be increasing numbers of jobs related to drafting, electronics, computers, and microprocessors, the tools of the information society.

In little more than a decade, microelectronics technology has blossomed from an expensive space-age curiosity into a force that is rapidly transforming our daily activities. A comparison of the wristwatches and children's toys of the late 1960's with the products available today is a good example of the massive changes underway. Most experts agree that the progress to date is merely a beginning of the "microchip revolution."

Microelectronics has given birth to the microprocessor and the computer-on-a-chip capability. These advances are now beginning to work their way into an increasing array of manufactured goods. Because of the technology's characteristic of developing new semiconductor components that are more powerful and cheaper, the current trend toward digital, solid-state products are certain to gain increasing momentum through the remainder of this century. Noted science writer Isaac Asimov said: "We can't stop the world from becoming digitized." The companies that turn out chips seem almost contemptuous of the gears, cams, limit switches, and other mechanical elements that are the guts of pre-electronics products. Electronic engineers relish the job of reducing such mechanical functions to digital circuits on a cornflake-size silicon chip. And once that has been done for a given type of product, chances are good that the mechanical predecessor will be at a cost and performance disadvantage--as many former makers of mechanical adding machines and watches can testify.

What do these changes mean to trade and vocational institutions serving the population of the Los Angeles area? Further, what do these changes mean for the instructional delivery system as presented at Los Angeles Trade-Technical College? In a post-

industrial society the programs will be significantly different from what they are today! Curriculum planners must combine the most useful technology of the past with as much understanding of current technology as can be incorporated.

Effective curriculum changes will come about based on the factors of need for trained/skilled technicians in the market place and the ability of Los Angeles Trade-Technical College to provide those trained potential employees using the facilities, equipment, and manpower available.

A recent Los Angeles Community College District study found that a representative sampling of 140 companies operating in the areas of computer science, electronics, and other high technology fields and employing more than 100,000 employees had specific training needs. A total of eighty-six percent of the respondents reported that they either experience or have difficulty in hiring skilled technicians (fifty-four percent), or that they experience difficulty "somewhat" (thirty-two percent). Eighty-five percent of the companies anticipate a need to employ additional skilled technicians in the next five years. The increase in the demand for skilled technicians during the coming years is,the study noted, going to heavily influence the composition of the workforce of Los Angeles.

In an attempt to provide the manpower necessary to meet the high technology technician needs of the Los Angeles production community, the following plan for total community participation in the high technology area is presented for consideration and approval.

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INSTRUCTIONAL MODEL

for

HIGH TECHNOLOGY PROGRAMS BY

HAROLD ECKES, CCORDINATOR

INSTRUCTIONAL MODEL FOR HIGH-TECHNOLOGY PROGRAMS

The High-Tech curriculum as outlined in these documents will present Los Angeles Trade-Technical College with a unique opportunity for the provision of a wide variety of educational programs for our community. Among these are the following:

1. High-Tech Curriculum Programs. Training will be provided in electronics engineering, electrical engineering, computer assisted manufacturing and computer assisted design. In addition, a full range of pre-engineering coursework will be identified and made available on a formal basis for the students at Los Angeles Trade-Technical College.
2. High-Tech for Foreign Students. This component of the instructional effort will seek to meet the counseling, advisement, and communication needs of foreign students seeking training in high technology.
3. Pre High-Tech Program. This component will identify and present instructional support in those basic skills necessary for successful student participation in the regular High-Tech curriculum. It is anticipated that a variety of basic skills learning programs for student enrichment will be made available through the Instructional Resources Laboratory of the Learning Resources Center as follows:

The pre high-tech program will identify and serve three groups of students:

1. Students whose low test scores do not qualify them for the high-tech program
2. Students on the waiting list for high-tech programs
3. Students in high-tech programs who need special assistance.

In order to serve the three groups above, the pre high-tech program will function as part of the Basic Skills Center and offer two levels of instruction:

Level I will be composed of three regular Basic Skills Center Courses: English 47 (Reading), English 64, and Math 30. These courses will be open entry/open exit in order to receive students at all times. Also, they will be modularized so that the final modules in each course can be tailored to the academic and career interests and skills of the students. Finally, these courses will be competency based in order to insure that their successful completion translates into a reasonable readiness for either Level II or the high-tech program.

Level II will be composed of three special courses in the Basic Skills Center.

These are: Reading for Technicians

Math for Technicians

Verbal and Non-Verbal Thinking

These courses will also be open entry/open exit, modularized, and competency based. Finally, the operation of the pre high-tech program will rely upon the full resources of the Basic Skills Center, which include certificated instructors, career and academic counseling, VEA para-professionals, EOP&S peer tutors, and the Instructional Resources Lab, including Computer Assisted Instruction.

4. High-Tech Instructional Contracts Program. This aspect of the curriculum will involve the identification of industries in the Los Angeles community that need specific high technology training classes for their employees. Los Angeles Trade-Technical College will provide the needed instruction, either on-campus or at off-campus locations, specifically tailored to meet the needs of the private sector employer.

5. Weekend College. This component will provide for a systematic exposure of the high technology curriculum on weekends to grade school level students utilizing the high-tech learning stations and the computer center facilities of Los Angeles Trade-Technical College. Regular teaching faculty will provide leadership roles in this effort to make more meaningful the impact of high technology in our productive efforts.

6. After School Enrichment. This component of the curriculum effort will be directed at providing exposure for junior and senior high school level students into the many aspects of high technology. Extensive use will be made of the high technology teaching stations and the computer center facilities. Regular teaching faculty will provide leadership roles in this activity. Career information will be highlighted.

PRE-TECH AFTER SCHOOL ENRICHMENT

The Los Angeles Trade-Technical College "Pre-Tech After School Enrichment Program" for junior and senior high school students will provide high-tech exposure and enrichment for thousands of young people in the Los Angeles Community.

The enrichment program will be available after school and on weekends. It will be geared to keep students abreast of the current state-of-the-art in the computer and electronics fields with emphasis on job skills and higher education.

Dedicated to providing an enrichment experience, the program will emphasize learning for pleasure with neither homework assigned nor grades given. A wide variety of classes, offering improvement in academic, fine-motor and creative skills will be offered.

For junior high school students, we will offer computer science classes dealing with the practical every-day application of the technology involved in the fields of microprocessing microwave, lasers and computers. For students who like being challenged, we will offer the opportunity to become a computer expert.

Senior high school students can take classes offering insight into the technology which is developing as a result of advances in the application of lasers and microchips.

Additionally, we will offer classes geared to help high school students prepare for the future. We will ask such questions as: Should he or she prepare for a job or a career? Will the job he or she is training for be there tomorrow? If college is the choice, should it be for two, four or more years? What skills and

career needs will today's high school student need to fit into tomorrow's high-tech job world? We will explore these questions and more as we take students into the world of technology directly related to computer developments.

THE SCHOOL OF SCIENCE, ENGINEERING AND TECHNOLOGY

Los Angeles Trade-Technical College is currently evaluating the establishment of a new instructional program format. The proposal includes the establishment of three schools within the instructional deanship. One of the proposed units is that of the School of Science, Engineering and Technology. This will include a new computer studies department, the departments of mathematics, physical and biological science, electronics, electrical-mechanical, and drafting.

"The school will stress high-tech program development. Upcoming projects include the reorganization of Trade-Tech's computer curriculum; the development of a pre-engineering curriculum; investigation into the development of a 'Robotics' program and the future development of various high-tech programs," notes Thomas G. Lakin, Dean of Instruction at Los Angeles Trade-Technical College.

THE COMPUTER CENTER

Los Angeles Trade-Technical College faculty and administration are currently involved in basic planning for the organization of a College Computer Center. This Computer Center, as projected, will play a vital role in the information handling routines of the college. It is envisioned that the Computer Center will serve as the central computing facility for all of the college. As the central campus computing facility, it will provide support for instruction, research and administrative computing services. Instructional consultants will be available to assist with programming problems and provide orientation in the use of the computer by faculty and students. The Computer Center will have access to the District computer services and will be linked to other computing facilities as the needs of the instructional program dictate.

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HIGH-TECHNOLOGY COLLEGE ADVISORY COMMITTEE

The demands of the community and industry determine the various phases of business, technical and trade training carried on by the college. Placement and successful progress of students are the measures of effectiveness of the pre-employment training. Increased productivity, job satisfaction, and advancement of the employed trainee attest to the effectiveness of the trade and technical extension programs. For these reasons all training at Los Angeles Trade-Technical College is developed and carried on with the advice and assistance of local advisory committees and industry consultants who are familiar with industrial needs and practices.

The High-Tech advisory will consist of members who are representatives of labor, management, and from federal, state, and local agencies which make consistent use of high technology in their productive efforts.

The High-Tech advisory committee will meet on the invitation of the college administration at least once a year and on occasions when considered necessary for programmatic needs. The High-Tech advisory committee will give counsel and advice in regard to evaluating training programs, approve plans to meet current training needs, review past accomplishments, and forecast trends affecting training and employment.

HIGH-TECHNOLOGY CURRICULUM FUTURISM

This curriculum proposal is, at base, a commitment on the part of the faculty, administration, and students at Los Angeles Trade-Technical College to be totally involved in integrating high technology concepts into all of our learning procedures. As newer applications of high technology make themselves known, we bind ouselves to the concept of exploration and involvement. This commitment will provide the needed catalyst to stimulate ongoing program review and revitalization in all curriculum areas which will eventually utilize the new high technologies.

HIGH TECHNOLOGY

ASSOCIATE IN SCIENCE

DEGREE PROGRAMS

ELECTRONICS ENGINEERING TECHNICIAN

TECHNOLOGY PROGRAM

VICTOR VELEY, ASSISTANT DEAN

PROPOSED CURRICULUM

ELECTRONICS ENGINEERING TECHNICIAN TECHNOLOGY PROGRAMS

Purpose of Curriculum

To produce a Research and Development Electronics Technician who will be hired by aerospace firms such as TRW, Hughes, Lockheed and Mc Donnell Douglas. These companies are currently represented on the Electronic Engineering Technician Advisory Committee.

The graduate will be proficient in the theory and operation of linear integrated circuits, operational amplifiers, microprocessors, microcomputers, microwave equipment, lasers and opto-electronic systems.

Starting salary (1982): - Approximately $1600 per month

Associate in Science Degree Requirements

A Certificate of Completion is awarded by satisfying the requirements of the essential courses listed below for a total of 48 units. For the Associate in Science Degree there is an additional requirement of 15 units in General Education.

Curriculum

Course Number	Description	Units
FIRST SEMESTER		
EET 11	DC, AC Fundamentals and Related Mathematics	6
EET 12	DC, AC Electronics Laboratory	6
SECOND SEMESTER		
EET 21	Theory of Solid State Devices	6
EET 22	Solid State Laboratory	6
THIRD SEMESTER		
EET 31	Theory of Linear Integrated Circuits, Operational Amplifiers, Microprocessors, Microcomputers, Communications Systems and related Mathematics	6
EET 32	Laboratory for Linear Integrated Circuits, Operational Amplifiers, Microprocessors, Microcomputers and Communications Systems	6
FOURTH SEMESTER		
EET 41	Theory of Microwave, Lasers and Opto-electronics	6
EET 42	Laboratory for Microwave, Lasers and Opto-electronics	6

COURSE DESCRIPTIONS

FIRST SEMESTER

EET 11 DC, AC FUNDAMENTALS AND RELATED MATHEMATICS 6 Units

Instruction is given in basic electrical concepts, electron theory, Ohm's Law, Kirchhoff's Laws, series circuits, parallel circuits, combination circuits, principles of magnetism and the care, use and construction of basic meters for voltage, current and resistance measurements. Problems illustrating accuracy necessary in measurements are given. Principles of alternating current, capacitance, inductance, reactance, resonance, transformers and alternating current measuring devices are taught.

The course also offers a review of basic arithmetic including addition, subtraction, multiplication, division, fractions, decimals, square roots, signed numbers, powers of ten and introduction to algebra.

EET 12 DC, AC ELECTRONICS LABORATORY 6 Units

Instruction and practice are given in general shop safety, care and use of hand tools and power tools, soldering techniques, hardware identification and use, chassis layout and forming, printed circuit techniques, components, color codes, symbols, direct current circuits, and measuring equipment. The student constructs and analyzes series and parallel RC, RL and RCL circuits, and becomes familiar with

AC test equipment. Special emphasis is placed on care and use of the oscilloscope and measurements of various wave shapes.

SECOND SEMESTER

EET 21 THEORY OF SOLID STATE DEVICES

Instruction is offered in the basic principles and applications of semi-conductor devices. Included are PN junction diodes, Zener diodes as a voltage reference, tunnel diodes, bipolar transistors, field effect transistors, diacs, triacs, integrated circuits, silicon controlled rectifiers and new devices as they are developed. Instruction is given in the theory and operation of power supplies, amplifiers, oscillators and mixers.

EET 22 SOLID STATE LABORATORY 6 Units

The student measures and analyzes the parameters and characteristics of solid state devices, studies some of their applications, and becomes familiar with the use of the curve tracer. The student also constructs, tests, and analyzes power supply circuits, amplifier circuits, oscillator circuits and mixer circuits. Trouble shooting procedures and techniques are introduced, including the logical selection, calibration, and accuracy determination of test instruments.

THIRD SEMESTER

EET 31 THEORY OF LINEAR INTEGRATED CIRCUITS, OPERATIONAL AMPLIFIERS, MICROPROCESSORS, MICROCOMPUTERS, COMMUNICATIONS SYSTEMS AND RELATED MATHEMATICS — 6 Units

Instruction is given in various communications systems using different forms of modulation. A study is made of logic and digital circuits together with an introduction to Boolean Algebra. The course also covers the theory of operational amplifiers, linear integrated circuits, microprocessors and microcomputers. This is associated with an introduction to differential and integral calculus.

EET 32 LABORATORY FOR LINEAR INTEGRATED CIRCUITS, OPERATIONAL AMPLIFIERS, MICROPROCESSORS, MICRO-COMFUTERS, AND COMMUNICATIONS SYSTEMS — 6 Units

Practice is offered in the operation and testing of various communications systems using different forms of modulation. IC digi-designers are used to build up and test various logic and digital circuits. These experiments are extended to include linear integrated circuits and operational amplifiers. The student is exposed to a complete microprocessor laboratory and to the operation and servicing of a microcomputer.

FOURTH SEMESTER

EET 41 THEORY OF MICROWAVE, LASERS AND OPTO-ELECTRONICS — 6 Units

A study is made of microwave theory and related systems.

The topics cover microwave sources, transmission lines, antennas, waveguides and include the use of the Smith Chart. The student is also exposed to geometrical and physical optics as they relate to ray tracing, lenses, photometry, opto-electronics, coherent light, fluorescence, interference and dispersion. Training is offered in the basic operation of a laser and the applications of laser beams. Subjects include color vision, interferometers, image processing, laser output, filters, laser speckles, fiber-optics, beam modulation and holography.

EET 42 LABORATORY FOR MICROWAVE, LASERS AND OPTO-ELECTRONICS

6 Units

Microwave measurements are made in the areas of frequency, power, VSWR and attenuation. The student conducts experiments in lens arrangements, photometry, fluorescence, interference and dispersion. Further experiments are involved with laser technology.

INSTRUCTOR AND CLASS REQUIREMENTS

Four first semester classes of 45 students each = 4 x 45 = 180 students

Four second semester classes of 35 students each =4 x 35 = 140 students

Four third semester classes of 30 students each = 4 x 30 = 120 students

Four fourth semester classes of 25 students each= 4 x 25 = 100 students

Total 540 students

Total number of FTE Instructors = 4 x 4 = 16.

Average Class size = $\frac{540}{16}$ = 34 students

PRIMARY PARAMETERS

ENROLLMENT

Due to an electronics waiting list of several hundred, it is not anticipated that enrollment will be a problem.

ATTRITION FACTOR

Anticipated Attrition Factor over the entire program = $\frac{20}{45}$ x 100 = 44%

GRADUATE PERCENTAGE

Percentage of initial enrollment completing the program = 56%

PLACEMENT

Due to the strong demand for electronic technicians, placement will be virtually 100% for all those seeking employment. It is anticipated that 10 to 15% of graduates will transfer to four year institutions.

BUDGET OUTLINE

		$
Total Salary of 16 FTE Instructors = 16 x 35000 (1982) =		560,000
Supplies		50,000
Equipment		75,000
	Total	685,000
Support Services @ 10%		68,500
	Total	$753,500

Cost per graduate = $ $\frac{753500}{100}$ = $7535

ADDITIONAL EQUIPMENT REQUIRED TO UPGRADE EXISTING PROGRAM TO "HI-TECH" LEVEL

100	B & K Triggered Oscilloscopes	$	40,000
150	Tektronix 60 MHz Oscilloscopes	$	200,000
50	IBM Microcomputers	$	300,000
25	HP Microprocessors Labs	$	30,000
50	HP Microwave Lab Systems	$	1,000,000
25	Tektronix Storage Oscilloscopes with Plug-in Units	$	150,000
25	Wavetek Signal Generators	$	100,000
	Laser and Opto-electronics Equipment	$	100,000
	Total	$	1,920,000

When the required equipment is purchased, the approximate cost will be $ 2,500,000. The equipment would have a maximum life expectancy of 10 years and its annual repair cost would be approximately $ 50000.

It would also be necessary to provide a new "High-Tech" Electronics Building or (preferably) to upgrade the existing "E" Building.

Present Status and Expansion Proposal

Approximately 125 students (4 classes) are presently enrolled in the Electronics Engineering Technician program at the annual cost of approximately $ 150,000. It is proposed that the program be expanded by 4 classes per year over a three year period to achieve a goal of 16 classes with an average class size of 34. The additional equipment cost could be defrayed over the same period of time.

PRE-TECH MODULES

A. DC, AC Theory and Laboratory

INDUSTRY MODULES

A. Field Effect Transistors. Theory and Laboratory. EET 21, 22 — 4

B. Integrated Circuits. Theory and Laboratory. EET 21, 22 — 4

C. Linear Integrated Circuits, Operational Amplifiers. Theory and Laboratory. EET 31, 32 — 4

D. Microprocessors and Microcomputers. Theory and Laboratory. EET 31, 32 — 4

E. Lasers and Opto-electronics. Theory and Laboratory. EET 41, 42 — 4

ATTENDANCE MODULES

Either (1) 6 hours per week for 20 weeks = 120 hours

or (2) 20 hours per week for 6 weeks = 120 hours

or (3) 24 hours per week for 5 weeks = 120 hours

The same attendance applies to all modules

Notes: (1) Courses and Modules could be videotaped for international distribution.

(2) Courses would be transferable to four year institutions. Approximately 28 units would be applied towards a Bachelor's Degree in Electronics Technology (Cal Poly, Cal State LA, Cal State Long Beach).

ELECTRICAL ENGINEERING TECHNICIAN

TECHNOLOGY PROGRAM

NEIL ADAMS, PH.D., COORDINATOR

ELECTRICAL ENGINEERING TECHNICIAN TECHNOLOGY PROGRAM

Purpose of the Curriculum

To provide thorough training for an Electrical Engineering Technician with a view to placement in "high technology" aspects of industry such as industrial or process control and instrumentation.

The graduate would be proficient in circuit analysis, theory and operation of machines, industrial electrical control, electrical and electronics drafting, as well as basic digital electronics theory. Starting salary would be approximately $1,500.00 per month.

Associate in Science Degree Requirements

A Certificate of Completion is awarded by completing the essential courses in the major for a total of 48 units. For the Associate in Science Degree the student must complete an additional 15 units in general education.

Curriculum

Course Number	Description	Hours Lect	Hours Lab	Units
FIRST SEMESTER				
Math 48	Technical Mathematics I	3	-	3
Physics 6	General Physics I	3	3	4
ELET 111	Basic Electrical Theory and Practice	1½	10	5
SECOND SEMESTER				
Math 49	Technical Mathematics II	3	-	3
Physics 7	General Physics II	3	3	4
ELET 121	Basic Electronics Theory and Practice	1½	7½	4
ELET 122	Electrical Drafting		3	1
THIRD SEMESTER				
Math 50	Technical Mathematics III	3	-	3
Chem II	Elementary Chemistry	3	3	4
ELET 131	Digital Electronics Theory and Practice	1½	7½	4
ELET 132	Drafting for Electronics		3	1

Course Number	Description	Hours Lect	Hours Lab	Units
FOURTH SEMESTER				
ELET 141	Electric Power Theory and Practice	2½	4½	4
ELET 142	Industrial Electrical Contrcl Theory and Practice	2½	4½	4
ELET 143	Industrial Electronic Control Theory and Practice	2½	4½	4

COURSE DESCRIPTIONS

FIRST SEMESTER

ELET 111 BASIC ELECTRICAL THEORY AND PRACTICE — 5 Units

Instruction is given in basic concepts, current, voltage, resistance, work, energy, power, RLC circuits, alternating current, complex AC circuits, network theorems, power in A.C. circuits, polyphase circuits and devices.

SECOND SEMESTER

ELET 121 BASIC ELECTRONICS THEORY AND PRACTICE — 4 Units

Instruction is given in semiconductor theory, rectification and power supplies, bipolar junction transistors, electronic amplifiers and field effect transistors.

ELET 122 ELECTRICAL DRAFTING — 4 Units

Instruction is given in techniques and lettering, pictorial drawing, device symbols, on line, elementary and riser diagrams; wire and cable schedules; power distribution drafting, electrical drawing for architectural plans.

THIRD SEMESTER

ELET 131 DIGITAL ELECTRONICS THEORY AND PRACTICE

Instruction is given in number systems, conversions, BCD code, switching, digital logic gates, flip flops, multivibrators, register, multiplexer, encoders and decoders; counters, D/A and A/D converters, micro-processors and applications.

ELET 132 DRAFTING FOR ELECTRONICS 1 Unit

Instruction is given in lettering, linework and symbols, electronic device representation, flow and logic diagrams, schematic diagrams, micro-electronics and microprocessors, computer aided drafting.

FOURTH SEMESTER

ELET 141 ELECTRICAL POWER THEORY AND PRACTICE 4 Units

Instruction is given in single and three phase power distribution, transformers, power distribution wiring, building electrical service entrance, feeders, branch circuits, meters and metering.

ELET 142 INDUSTRIAL ELECTRICAL CONTROL THEORY AND PRACTICE 4 Units

Instruction is given in measuring instruments, transformer connections, relays, starters, controllers, magnetic reversing controls, start-jog-stop control, and low voltage and DC controls.

ELET 143 INDUSTRIAL ELECTRONIC CONTROL THEORY AND PRACTICE 4 Units

Instruction is given in negative feedback concepts, process control, sensors and transducers, pressure flow, and temperature measurement, process controllers.

PROGRAM REQUIREMENTS

Two First Semester Classes: 2 X 35 = 70 students

Two Second Semester Classes: 2 X 30 = 60 students

Two Third Semester Classes: 2 X 25 = 50 students

Two Fourth Semester Classes: 2 X 20 = 40 students

TOTAL = 220 students

Total number of FTE Instructors:

$$2 \times \frac{57}{21} = 6$$

Average Class Size: $= \frac{220}{8} = 27.5$ students

Attrition Factor: $= \frac{15}{35} \times 100 = 43\%$

Vitality Factor: $= \frac{20}{35} \times 100 = 57\%$

PLACEMENT:

It is anticipated that all who successfully complete the program will be placed.

BUDGET OUTLINE

1. INITIAL START-UP INVESTMENT

a) EQUIPMENT

12	ea	Trainers AC/DC	$ 6,000.00
12	ea	Trainers, basic electronics	$ 7,200.00
12	ea	Trainers, digital logic	$ 12,000.00
6	ea	Trainers, electrical-mechanical laboratory	$ 60,000.00
6	ea	Trainers, motor control	$ 24,000.00
6	ea	Trainers, static control	$ 24,000.00
		Total	$133,200.00

b) INSTRUMENTATION

6	ea	Oscilloscopes dual trace	$ 6,000.00
12	ea	Power supplies AC/DC	$ 6,000.00
12	ea	Multimeters digital	$ 6,000.00
12	ea	Voltmeter/ammeter	$ 5,400.00
12	ea	Generator, A.F.	$ 2,600.00
12	ea	Generator, function	$ 6,000.00
		Sub Total	$ 32,000.00

c) TOTAL INITIAL INVESTMENT $165,200.00

2. ANNUAL BUDGET

Salary for 6 FTE Instructors	$210,000.00
Salary for 2 FTE Instructors (in Support Department)	$ 70,000.00
Equipment (new, replacement, etc.)	$ 31,100.00
Supplies	$ 15,000.00
	$ 16,000.00
	$311,000.00
Support services @ 10%	$342,100.00
Total Annual Budget	$342,100.00

Cost per graduate = $\frac{\$342,100.00}{40}$ = $8,550.00

PRE-TECH MODULES

A. Basic D.C. and A.C. Theory and Laboratory 4

ELET 111

B. Polyphase Circuit Theory and Application 4

Three phase circuits; transformers; generators; motors; solar cells and fuel cells.

ELET 111

INDUSTRY MODULES

A. Transistor Theory and Practice 4

ELET 121

B. Electronic Amplifiers Including Operational Amplifiers 4

ELET 121

C. Digital logic with industrial applications 4

ELET 131

D. Microprocessors with applications in control 4

ELET 131

E. Electrical Power Distribution 4

ELET 141

F. Industrial Motor Control 4

ELET 142

F. Process Instrumentation and Control 4

ELET 143

MACHINE SHOP COMPUTER

ASSISTED MANUFACTURING

TECHNICIAN TECHNOLOGY PROGRAM

JOE RIOS, COORDINATOR

MACHINE SHOP COMPUTER ASSISTED MANUFACTURING TECHNICIAN TECHNOLOGY PROGRAM

Purpose of Curriculum

The purpose of the curriculum is to prepare a Technician in Computer Assisted Programming. The graduate will be hired by a wide variety of manufacturing and processing firms, such as tool and die, mold making companies and other industries related to metal fabrications.

The graduate will be trained in computer languages including Automatic Program Tool, Compact II, process control in manufacturing and Computer Numerical Control in two and three axis machines.

Associate in Science Degree Requirements

A certificate of completion is awarded by satisfying the requirements of the essential courses listed below for a total of 48 units. For the Associate in Science Degree there is an additional requirement of 15 units in general education.

(Up to 24 units of credit may be awarded for past manufacturing experience and passing a proficiency exam with a passing grade of 80% or higher.)

Associate in Science Degree

This program is being offered because of the expansion of computer technology in the manufacturing processes.

At the completion of the course of study, the student will have knowledge of several computer languages applicable to numerical control programming.

Current salary at the entry level is approximately $9/hr., experienced up to $30.00/hr.

TYPE OF STUDENT

This program will be a high technology track in a two track machine technology program. The students will be selected on the basis of having completed the first two semesters of machine shop training at Trade-Tech or having equivalent industrial experience and in both cases also passing an entrance exam into the high technology "cam" program.

ENTRANCE EXAM

Entrance to "high tech" program track will be based on a written exam based in the areas of English, math and machine knowledge.

ENGLISH - Having completed English 21 or equivalent.

MATH - Passing a proficiency exam on basic algebra, plane geometry, and basic shop trigonometry.

MACHINE SHOP - Pass a written exam on milling machines, and engine lathe practices.

TYPE OF INSTRUCTORS

Within one year, the department should hire up to 5 FTEs to meet the demands of the new program. Four instructors will be needed in the machine shop and one in plastics technology. Since this program is an industrial type of curriculum, the instructors should have an extensive background in industry. Recommendations of instructors should be reinforced by input from the trade advisory committees.

STUDENT PROJECTIONS

It is recommended that this program start at the third semester level. Morning and afternoon classes will be adjusted to meet student demands. Because of the highly technical nature of the classes and equipment, the class enrollment should not exceed 25 students per instructor.

Curriculum

Course Number	Course Titles	Units
FIRST SEMESTER		
MACHSP 111	Principles of Machine Tools I	3
MACHSP 112	Technology and Applications of Machine I	5
MACHSP 113	Machine Shop Mathematics I	3
MACHSP 114	Blueprint I	3
SECOND SEMESTER		
MACHSP 121	Principles of Machine Tools II	3
MACHSP 122	Technology and Application of Machine II	5
MACHSP 123	Machine Shop Mathematics II	3
MACHSP 124	Blueprint II	3
THIRD SEMESTER		
MACHSP 171	Principles of Numerical Control	4
MACHSP 171A		3
MACHSP 171B		1
MACHSP 172	Manual Programming and Operation Numerical Control Lathes	5
MACHSP 172A		3
MACHSP 172B		2
MACHSP 173	Manual Programming and Operation of Numerical Control Milling Machines	4
MACHSP 173A		3
MACHSP 173B		1

Curriculum

Course Number	Course Titles	Units
FOURTH SEMESTER		
MACHSP 181	Automatic Programmed Tool (A.P.T.)	4
MACHSP 181A		3
MACHSP 181B		1
MACHSP 182	Compact II (M.D.S.I.)	4
MACHSP 182A		3
MACHSP 182B		1
MACHSP 183	C.A.D./C.A.M. (Computer Assisted Design/Computer Assisted Manufacturing	4
MACHSP 183A		3
MACHSP 183B		1
MACHSP 184	DIRECTED COMPUTER STUDIES	3

COURSE DESCRIPTIONS

FIRST SEMESTER

MACHSP 111 PRINCIPLES OF MACHINE TOOLS I — 3 Units

This course covers the principles of basic hand tools and machine tools such as drills, files, taps, reamers, lathes, milling machines, drill presses, saws, and pedestal grinders. Safety and good shop practice are emphasized. This course includes lecture and laboratory demonstration.

MACHSP 112 TECHNOLOGY AND APPLICATIONS OF MACHINE I — 5 Units

Basic machine shop instruction is offered in the technology and application of machining. Areas such as filing, threading, tapping, layout, and free-hand grinding are explored. Also, the basic set-ups and operation of drill presses, lathes, and milling machines, along with safety are emphasized.

MACHSP 113 MACHINE SHOP MATHEMATICS I — 3 Units

A review of the fundamentals of arithmetic is offered with emphasis on decimals. Elementary arithmetic principles are applied to machine tools and machining problems.

MACHSP 114 BLUEPRINT — 3 Units

This course offers instruction in the principles of reading and interpreting industrial blueprints as applied to the machine trade.

SECOND SEMESTER

MACHSP 121 'PRINCIPLES OF MACHINE TOOLS II — 3 Units

Lecture, laboratory and demonstrations.

Advanced principles of lathes and milling machines, their attachments and accessories. Principles of special turning and milling machines.

Introduction to advanced machinery.

MACHSP 122 TECHNOLOGY AND APPLICATION OF MACHINE II — 5 Units

Technology of machining, metals and metal removal process, speeds and feeds. Form tools, use of related tools in machining of metals and materials. Set-ups related to attachments/accessories on lathes and milling machines.

MACHSP 123 MACHINE SHOP MATHEMATICS II — 3 Units

Ordering of operations, exponents, algebra (related), algebraic equations, geometry - plane and solid, surface, volumetric and weight measurements.

MACHSP 124 BLUEPRINT II — 3 Units

Special view and assembly drawings. Production blueprints; linear tolerancy and dimensioning; introduction to geometric tolerancing and dimensioning; introduction to sketching.

THIRD SEMESTER

MACHSP 171 PRINCIPLES OF NUMERICAL CONTROL — 4 Units

171A This course covers the basic principles and

171B operations related to Numerical Control equipment. Areas such as history, development, cartesian

coordinate system, key punching, manual programming and manual operation are emphasized.

MACHSP 172 MANUAL PROGRAMMING AND OPERATION NUMERICAL 5 Units

172A CONTROL LATHES

172B This course covers intermediate manual programming of N.C. and C.N.C. lathes using various canned-cycles and sub-routines such as facing, turning, boring, threading and contouring in 2 axis.

MACHSP 173 MANUAL PROGRAMMING AND OPERATION OF NUMERICAL 4 Units

173A CONTROL MILLING MACHINES

173B This course covers intermediate manual programming of N.C. and C.N.C. milling machines, using various canned cycles and sub-routines such as milling, contouring, drilling, tapping and boring in 3-axis machines.

FOURTH SEMESTER

MACHSP 181 AUTOMATIC PROGRAMMED TOOL (A.P.T.) 4 Units

181A This course provides instructions for

181B programming various machine tools using motion such as macros, looping, copying and tra-cut statements using the computer language A.P.T.

MACHSP 182 COMPACT II (M.D.S.I.) 4 Units

182A This course provides instruction in defining

182B part geometry from engineering drawings, cutter tool paths necessary to manufacture machine parts using the computer language COMPACT II, in programming of two to four axis machine tools.

MACHSP 183 C.A.D./C.A.M. (COMPUTER ASSISTED DESIGN/ 4 Units

183A COMPUTER ASSISTED MANUFACTURING)

183B C.A.D./C.A.M. as applied to the Tool and Die field, mold design and manufacturing; this course provides instruction in computer assisted design of tooling and computer assisted manufacturing and programming of various machine tools.

MACHSP 184 DIRECTED COMPUTER STUDIES 3 Units

This course provides instruction in preparing special projects drawn from such fields as Aerospace, Civil, Electrical, Electronics, Mechanical, Plastics or Machine Shop. Individual problems are assigned to students under the guidance of an instructor, with particular consideration being given to Drafting, Mathematics, Fabrication and design of project.

EQUIPMENT REQUIRED TO ESTABLISH CAM HIGH-TECHNOLOGY PROGRAM

1. Computer "Mini"

   6 to 10 terminals with CRTs

   2 line printers (high speed)

   2 high speed punchers

   2 plotters

2. Software

   Compact II

   APT

   CAD

   CAM

   PROCESS CONTROL

3. Machinery

   Bridgeport 20 tool changer mill

   Horizontal machining center

   CNC lathe

   4 teletypes

   6 flex-o-writers

   Conversion of Cintimatic EIA to ASCII control

   Bridgeport CNC series I milling machine

   CNC inspection and layout table

   1 each Bridgeport BTC-1

   2 each Bridgeport CNC-1

   4 each Bridgeport BRJ

   3 each Maho MH 400 P with 1 Spanish readout

   8 each engine lathes

1 each Maho MC 600 with changer (pallet) with tape reader, Punch Comb

1 each Daewoo Puma 10

1 each Maho MH 400 C with NC rotary table

1 each Boice measuring system 301 series

1 each General Numeric system P model D with X, Y axis

12 each Bridgeport digital readout system X,Y axis

4. Process Control (plastics technology)

2 Newburry injection molding machines

2 Arburg injection molding machines

1 Computer tie-in

1 Desikin dryer

1 Storage area with ventilation

BUDGET OUTLINE

Initial Start-Up Investment:	
Computer (Mini) and accessories	$ 200,000.00
Equipment	800,000.00
Remodeling and Alterations	30,000.00
Total Initial Investment	$1,030,000.00

Annual Budget:	
Instructors 5 (FTE) @ 35,000	$ 200,000.00
Supplies	10,000.00
Total Annual Budget	$ 210,000.00

(COMPUTER AIDED DESIGN-COMPUTER AIDED MANUFACTURING)

TECHNICIAN TECHNOLOGY PROGRAM

PROPOSED CURRICULUM

JOE RIOS

(COMPUTER AIDED DESIGN-COMPUTER AIDED MANUFACTURING)

TECHNICIAN TECHNOLOGY PROGRAM

PROPOSED CURRICULUM

Purpose of Curriculum

To thoroughly train a CAD-CAM Technician for placement in Aerospace and commercial products firms.

The graduate will be proficient in the theory and operation of machine tools, applied mathematics, mechanical design graphics and specialized manufacturing processes and systems.

Emphasis will be on computer assistance in all areas.

The curriculum will involve the areas of Computer Science, Drafting, Machine Shop and Plastics.

Starting Salary (1982): Approximately $1,700.00 per month.

Associate in Science Degree Requirements

A Certificate of Completion will be awarded by satisfying the requirements of the essential courses listed below for a total of 48 units.

For the Associate in Science Degree there is an additional requirement of 15 units in general education.

Prerequisite

Student must pass a high school level English and mathematics examination before being admitted to this program.

Curriculum

Course Number	Course Titles	Units
FIRST SEMESTER		
MFG 111	Theory of Machine Tools & Manufacturing Processes I	3
MFG 112	Operation and Application of Manufacturing Related Machines I	5
MFG 113	Mathematics Applied to Manufacturing I	3
MFG 114	Mechanical Design Graphics I	3
SECOND SEMESTER		
MFG 121	Theory of Machine Tools & Manufacturing Process II	3
MFG 122	Operation and Application of Manufacturing Related Machines II	5
MFG 123	Mathematics Applied to Manufacturing II	3
MFG 124	Mechanical Design Graphics II	3
THIRD SEMESTER		
MFG 131	Principles of CAD-CAM Related Manufacturing I	3
MFG 132	Operation of CAD-CAM Related Machines I	4
MFG 133	Mathematics Applied to CAD-CAM I	3

Course Numbers	Course Titles	Units
FOURTH SEMESTER		
MFG 141	Principles of CAD-CAM Related Manufacturing II	3
MFG 142	Operation of CAD-CAM Related Machines II	4
MFG 143	Mathematics Applied to CAD-CAM II	3

INITIAL INSTRUCTOR AND CLASS REQUIREMENTS

One First Semester Class	35 students
One Second Semester Class	26 students
Combined Third and Fourth Semester Classes	35 students
TOTAL	96 students

Total number of F.T.E. Instructors = 3

Average class size = $\frac{96}{3}$ = 32

PRIMARY PARAMETERS

ENROLLMENT

Enrollment will include those students with a basic educational background who want an extensive manufacturing training. They will be exposed to the latest developments in the areas of Drafting/Design, Machine Shop, Plastics, and Computer Science as they relate to manfacturing.

ATTRITION FACTOR

Anticipated Attrition Factor over the entire program = $\frac{17\frac{1}{2}}{35} \times 100 = 50\%$

GRADUATION PERCENTAGE

Percentage of initial enrollment completing the program = 50%.

PLACEMENT

Due to the demand for technicians with extensive manufacturing training, many will be enticed by industry into full-time employment prior to completion of the program.

It is anticipated that 25% of the graduates will transfer to four-year institutions.

BUDGET OUTLINE

TOTAL Salary of 3 F.T.E. Instructors = 3 x 35,000 (1982) =		$105,000.00
Supplies		$ 9,000.00
		$114,000.00
Support Services @ 10%		$ 11,400.00
	TOTAL	$125,400.00

Cost per graduate = $\frac{125,400}{14}$ = $8,958.00

ADDITIONAL

					QTY	
Proposal I		IBM (CADAM)				
IBM	4331	Computer		$90,000.00	1	$ 90,000.00
IBM	3278	CRT & Keyboard (Communicate with) (Computer Operations)		$ 4,000.00	1	$ 4,000.00
IBM	3258	Channel Control Unit (Controls IBM 3255 +) (IBM 3251's)		$37,000.00	1	$ 37,000.00
IBM	3255	Display Controller		$35,000.00	1	$ 35,000.00
IBM	3251	Display Station	Ea.	$16,500.00	4 min.	$ 66,000.00
IBM	2501	Cardreader		$18,000.00	1	$ 18,000.00
VERSATEC PLOTTER		(Electrostatic)		$ 7,000.00	2	$ 14,000.00
SOFTWARE			1st year	$55,000.00 then 30K/yr.	1	$ 55,000.00
						$319,000.00 + $ 30,000.00/yr.

Proposal II	COMPUTERVISION CAD-CAD			
Microprocessor		$180,000.00	1	$180,000.00
CRT TERMINAL	Ea.	$ 49,000.00	4 min.	$196,000.00
(Roster Type)		$ 30,000.00	1	$ 30,000.00
Blind Digitiser		$ 38,000.00	1	$ 38,000.00
Plotter (Pen Type)		$ 45,000.00	1	$ 45,000.00
Electrostatic Plotter		$ 12,000.00	1	$ 12,000.00
Reader & Taper Punch		$ 12,000.00	2 min.	$ 24,000.00
Software 12K per package (Mech. Design & N/C)				$525,000.00

PRE-TECH MODULES

Students will be able to take any of the following courses prior to enrolling in the CAD-CAM Technician Program:

MFG 101 Introduction to Computer Science

MFG 102 Introduction to Drafting

MFG 103 Introduction to Machine Tools

MFG 104 Introduction to Plastics Technology

EITHER: (A) 6 Hours per week for 20 weeks = 120 Hours

(B) 20 Hours per week for 6 weeks = 120 Hours

(C) 24 Hours per week for 5 weeks = 120 Hours

INDUSTRY MODULES

MFG 151 Analysis of CAD (Computer Aided Design)

MFG 152 Analysis of CAM (Computer Aided Manufacturing)

MFG 153 Analysis of Industrial Computer Systems

NOTES: (1) Courses and Modules would be videotaped for international distribution.

(2) Courses would be transferable to four-year institutions. Approximately 28 units would be applied toward a Manufacturing Engineering Degree at California State University, Long Beach, or Industrial Arts at California State University, Los Angeles.

SCIENCE-MATH DEPARTMENT

HIGH TECHNOLOGY

SUPPORT SERVICES

LUCIAN CARTER, CHAIRPERSON

SCIENCE-MATH HIGH TECHNOLOGY SUPPORT SERVICES

The Science-Math Department is prepared to participate in the implementation of the high technology program at Los Angeles Trade-Technical College. The role the department will play is divided into three parts:

1) provide academic support to high-tech programs in other departments;
2) upgrade trade programs presently in the Science-Math Department such as laser technology and genetic engineering; and
3) possible establishment of new programs.

The department is presently providing academic support to the electronics, electrical-mechanical, and art trades departments. The department now teaches physics to students enrolled in electronics, air conditioning technology, refrigeration mechanics, electrical construction and maintenance, and chemical technology. Instructional support is also provided to teach chemistry to students enrolled in air conditioning technology and photography classes. The department also helps prepare students in the Health Nursing and Service Occupations Department, teaching biology, microbiology and physiology. All of these services could be expanded and upgraded to prepare students for a higher level of understanding of the background science in high-tech programs.

Certainly, any high-tech program developed will require an extensive background in mathematics on the part of participating students. The department presently offers beginning math classes through first year calculus, many of which are appropriate in

high-tech programs that might be developed with little change. The department is presently providing applied math courses as well as specifically tailored courses in electrical construction, refrigeration mechanics, building trades, and chemical technology. These courses are available for incorporation into high-tech programs. If more advanced math courses should be needed, such as differential equations, advanced calculus, vector analysis, etc., the department will offer them.

The department also offers courses in computer programming and will cooperate in the proposed establishment of computer science program.

A possible candidate for the development of a high-tech program in the Science-Math Department is the chemical technology program. Presently this program is kept up-to-date with the latest state-of-the-art models. This will continue as the revolution in electronics has its impact in the field of chemical analysis. There are many future elective options in high technology related to chemical technology. Some of those options are:

1) Radioactive Materials Handling Technician
2) Recombinant DNA and related Bio-Chemical Techniques
3) Materials Science Technician (with the incorporation of metallurgical and ceramic engineering technology)
4) Cooperative venture between the Science-Math Department and the Electronics Department to train Laser Technicians.
5) Joint venture between the Science-Math Department and Electrical-Mechanical Department to train Solar Energy Technicians.

Although some areas may not show immediate high enrollment figures, all areas are destined to be in demand.

SUMMARY OF ASSOCIATE IN SCIENCE DEGREE PROGRAMS

1. Electronics Engineering Technician

The program presently offered requires four FTE instructors with four classes and trains 125 students. The plan is to expand the program over a three year period to 16 FTE instructors with 16 classes and over 500 students. The classes would primarily be held between noon and 5 pm to optimize the use of the electronics facility. To upgrade the program to the level of high technology would require in equipment, an investment of $ 2.0 to $ 2.5 million.

2. Electrical Engineering Technician

This is a new interdisciplinary program involving the Electro-Mechanical, Drafting, Electronics and Science-Math Departments. When in full operation, it would require six FTE instructors and would train 220 students. Approximate start-up cost is estimated at $ 150,000.

3. Computer Assisted Manufacturing (CAM)

The first year of this program is based on existing machine shop courses which have been upgraded. The second year is a new high technology track related to computer assisted manufacturing and computer assisted design (CAD). When the program is in full operation, it would require five FTE instructors and would instruct approximately 125 students. The equipment start-up cost is approximately $ 1 million.

4. Computer Assisted Manufacturing, Computer Assisted Design (CAM/CAD)

This is an entirely new interdisciplinary program which would involve the Metals, Computer Science, Drafting and Science/Math Departments. When the program is in full operation, it would require three FTE instructors and would instruct 96 students. Initial start-up equipment cost is estimated to be $850,000.

SUMMARY OF PRE-TECH AND INDUSTRY MODULES

ELECTRONICS ENGINEERING TECHNICIAN

Pre-Tech Module

A. DC, AC Theory and Laboratory.

Industry Modules

A. Field Effect Transistors. Theory and Laboratory.

B. Integrated Circuits. Theory and Laboratory.

C. Linear Integrated Circuits, Operational Amplifiers. Theory and Laboratory.

D. Microprocessors and Microcomputers. Theory and Laboratory.

E. Lasers and Opto-Electronics. Theory and Laboratory.

ELECTRICAL ENGINEERING TECHNOLOGY

Pre-Tech Modules

A. Basic D.C. and A.C. Theory and Laboratory.

B. Polyphase Circuit Theory and Application. Theory and Laboratory.

Industry Modules

A. Transistor Theory and Practice.

B. Electronics Amplifiers Including Operational Amplifiers.

C. Digital Logic with Industrial Applications.

D. Microprocessors with Applications in Control.

E. Electrical Power Distribution.

F. Industrial Motor Control.

G. Process Instrumentation and Control.

COMPUTER ASSISTED MANUFACTURING TECHNICIAN

Industry Modules

A. COMPACT II Programming of Machine Tools.

B. APT Programming of Machine Tools.

COMPUTER ASSISTED DESIGN TECHNICIAN

Pre-Tech Modules

A. Introduction to Computer Science.

B. Introduction to Drafting.

C. Introduction to Machine Tools.

D. Introduction to Plastics Technology.

Industry Modules

A. Analysis of CAD (Computer Aided Design)

B. Analysis of CAM (Computer Aided Manufacturing).

C. Analysis of Industrial Computer Systems.

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